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Foodborne Disease Outbreaks, 5-Year Summary, 1983-1987

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This report summarizes data from foodborne disease outbreaks reported to CDC from 1983 through 1987. With a few exceptions, an outbreak is defined as an incident in which two or more persons experience a similar illness and food is implicated. During this period, 2,397 outbreaks of foodborne disease were reported, representing 91,678 cases. Among outbreaks in which the etiology was determined, bacterial pathogens caused the largest number of outbreaks (66%) and cases (92%). Chemical agents caused 26% of outbreaks and 2% of cases. Parasites caused 4% of outbreaks and less than 1% of cases, and viruses caused 5% of outbreaks and 5% of cases. The discrepancies between the number of outbreaks and the number of cases attributed to each etiologic agent emphasizes the importance of evaluating both numbers before drawing conclusions. The etiologic agent was not determined in 62% of outbreaks, reflecting the need for improved investigative skills. The number of outbreaks reported by this surveillance system is only a small fraction of the true number that occur. The likelihood of an outbreak's being reported depends on many factors, such as ease of recognition and ease of laboratory confirmation. Sporadic foodborne illness is far more common and is not included in this report. INTRODUCTION

The reporting of foodborne and waterborne diseases in the United States began over half a century ago when state and territorial health officers, concerned about the high morbidity and mortality caused by typhoid fever and infantile diarrhea, recommended that cases of enteric fever be investigated and reported. The purpose was to obtain information about the role of food, milk, and water in outbreaks of intestinal illness as the basis for public health action. Beginning in 1923, the Public Health Service published summaries of outbreaks of gastrointestinal illness attributed to milk. In 1938, it added summaries of outbreaks caused by all foods. These early surveillance efforts led to the enactment of important public health measures that had a profound influence in decreasing the incidence of enteric diseases, particularly those transmitted by milk and water.

From 1951 through 1960, the National Office of Vital Statistics reviewed reports of outbreaks of foodborne illness and published summaries of them annually in Public Health Reports. In 1961, CDC--then the Communicable Disease Center--assumed responsibility for publishing reports on foodborne illness. For the period 1961-1965, CDC discontinued publication of annual reviews but reported pertinent statistics and detailed individual investigations in the MMWR.

In 1966, the present system of surveillance of foodborne and waterborne diseases began with the incorporation of all reports of enteric disease outbreaks attributed to microbial or chemical contamination of food or water into an annual summary. Since 1966, the quality of investigative reports has improved,

primarily as a result of more active participation by state and federal agencies in the investigation of foodborne and waterborne disease outbreaks. Because of increasing interest and activity in waterborne disease surveillance, foodborne and waterborne disease outbreaks were reported in separate annual summaries in the period 1978-1982. This report summarizes data from foodborne disease outbreaks reported to CDC from 1983 through 1987.

Foodborne disease surveillance has traditionally served three objectives:

1. Disease Prevention and Control. Early identification and

removal of contaminated products from the commercial market, correction of faulty food-preparation practices in food-service establishments and in the home, and identification and appropriate treatment of human carriers of foodborne pathogens are the main prevention and control measures that result from surveillance of foodborne disease.

2. Knowledge of Disease Causation. The responsible pathogen was not identified in over half of the foodborne disease outbreaks reported to CDC between 1983 and 1987; this proportion is similar to that of earlier years. In many of these outbreaks, pathogens known to cause foodborne illness may not have been identified because laboratory investigations were late or incomplete. In others, the responsible pathogen may have escaped detection even after a thorough laboratory investigation, either because the pathogen may not have been recognized as a cause of foodborne disease or because the pathogen could not be identified by available laboratory techniques. When more thorough clinical, epidemiologic, and laboratory investigations are conducted, perhaps many of these pathogens can be identified, and suitable measures for prevention and control can be instituted.

3. Administrative Guidance. The collection of data from investigations of foodborne disease outbreaks permits the assessment of trends in the prevalence of etiologic agents and in vehicles of disease transmission. In addition, it brings to light common errors in food handling. The compilation and publishing of annual data enable local and state health departments and others involved in the implementation of food protection programs to be kept informed of the factors involved in foodborne disease outbreaks. Comprehensive surveillance should result in a greater awareness of the most important food protection methods, the institution of better training programs, and more effective use of available resources.

METHODS Definition of Outbreak

For the purpose of this report, a foodborne disease outbreak is defined as an incident in which 1) two or more persons experience a similar illness after ingestion of a common food, and 2) epidemiologic analysis implicates the food as the source of the illness. A few exceptions exist; for example, one case of botulism or chemical poisoning constitutes an outbreak.

Outbreaks of known etiology are those for which laboratory evidence of a specific agent is obtained and specified criteria are met. Outbreaks of unknown etiology are those for which epidemiologic evidence implicates a food source, but adequate laboratory confirmation is not obtained. Outbreaks of unknown etiology are subdivided into four subgroups by incubation period of the illnesses: less than 1 hour (probable chemical poisoning), 1-7 hours (probable *Staphylococcus* food poisoning), 8-14 hours (probable *Clostridium perfringens* food poisoning), and greater than 14 hours (other infectious or toxic agents).

Source of Data

Outbreaks are reported to CDC on a standard reporting form. Reports come most frequently from state and local health departments; they may also be received from federal agencies such as the Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), the U.S. Armed Forces, and occasionally from private physicians. Forms are reviewed at CDC to determine whether a specific etiologic agent or vehicle for the outbreak can be confirmed. In some instances, questions about an etiologic agent may be referred back to the reporting agency; otherwise, data are accepted as reported on the forms.

Interpretation of Data

The limitations on the quantity and quality of data presented here must be recognized in order to avoid misinterpretation. The number of outbreaks of foodborne disease reported by this surveillance system clearly represents only a small fraction of the outbreaks that occur. The likelihood of an outbreak's coming to the attention of health authorities varies considerably depending on consumers' and physicians' awareness, their interest, disease surveillance activities of state and local health and environmental agencies, and their motivation to report the incident. For example, large outbreaks; interstate outbreaks; restaurant-associated outbreaks; and outbreaks involving serious illness, hospitalizations, or deaths are more likely to come to the attention of health authorities than cases of mild illness after a family cookout.

The quality of the data presented here depends upon the commitment to surveillance of this type of disease by state or local health departments. A department's interest in foodborne disease and its investigative and laboratory capabilities are important determinants of the quality of the investigation. Furthermore, the likelihood that the findings of the investigation will be reported varies from one locality to another. This report, then, should not be the basis of firm conclusions about the absolute incidence of foodborne disease, nor should it be used to draw conclusions about the relative incidence of foodborne diseases by specific causes. For example, foodborne diseases characterized by short incubation periods, such as those caused by a chemical agent or staphylococcal enterotoxin, are more likely to be recognized as common-source foodborne disease outbreaks than those diseases with longer incubation periods, such as hepatitis A. Outbreaks involving less common pathogens, such as *Bacillus cereus*, *Escherichia coli*, or *Giardia lamblia* are less likely to be confirmed because these organisms are often not considered in clinical, epidemiologic, and laboratory investigations of foodborne disease outbreaks. Also, pathogens that generally cause mild illness will be underrepresented, whereas those causing serious illness, such as *Clostridium botulinum*, are more likely to be identified. Similarly, outbreaks associated with restaurants or commercial products have a higher likelihood of being reported.

The categorization of food vehicles can be a source of confusion. Many foods contain a variety of ingredients, yet each food vehicle of transmission is listed under only one food-vehicle category. For example, homemade ice cream made with milk and eggs is listed under "ice cream" rather than under "milk" or "eggs." The category "Mexican food" includes vehicles made with beef, cheese, lettuce, and other ingredients. The reported number of outbreaks attributed to one food-vehicle category often does not include all outbreaks due to a particular ingredient in that food.

The outbreak data reported here represent only a small and selected fraction of foodborne illness in the country. Outbreaks produced by different agents vary considerably in size. In assessing the magnitude of the problem due to any food vehicle or pathogen, one should examine the number of cases involved in the outbreaks as well as the number of outbreaks. In addition, sporadic cases of foodborne illness are far more common than cases associated with outbreaks. With the exception of botulism and a few chemical exposure diseases, sporadic cases are not reported to this surveillance system. RESULTS

The results are presented by subject and etiologic agent for each of the five years, as follows: outbreaks, cases, and deaths (Tables 1-5), vehicles of transmission (Tables 6-10), place where food was eaten (Tables 11-15), month of occurrence (Tables 16-20), and contributing factors (Tables 21-25). 1983

In 1983, 505 outbreaks (14,898 cases) of foodborne diseases were reported to CDC. Reports were received from 39 states as well as from the District of Columbia and Guam (Figure 1). New York reported the largest number of outbreaks (174), with 80 from New York City; Washington reported the next largest number (38), followed by California (30), Hawaii (23), and Massachusetts (23). The etiologic agent was confirmed in 187 (37%) of the 505 outbreaks (Table 1).

Bacterial pathogens accounted for 127 outbreaks (7,082 cases). *Salmonella* caused most of the bacterial foodborne disease outbreaks (72 outbreaks, 2,427 cases), followed by *Staphylococcus aureus* (14 outbreaks, 1,257 cases), and *C. botulinum* (13 outbreaks, 46 cases). An outbreak of illness due to *Listeria monocytogenes* was associated with consumption of one brand of pasteurized milk in New England. Forty-two immunosuppressed adults and seven fetuses or newborns accounted for the 49 cases in Massachusetts. Fourteen (29%) cases were fatal. An outbreak of *Brucella melitensis* infections due to

unpasteurized goat cheese occurred in Texas. All 29 persons affected were Mexican immigrants; 14 were hospitalized, and one person died. The cheese was reportedly produced in Mexico and was purchased from unlicensed vendors who sold it from their cars. A large outbreak of *Shigella dysenteriae* type 2 infections occurred among persons who ate at a Maryland hospital cafeteria; 1,502 persons were ill, and 24 were hospitalized. Illness was associated with consumption of raw vegetables at a cafeteria salad bar.

Chemical agents caused 45 outbreaks (264 cases): ciguatoxin caused 13 outbreaks (43 cases), and scombrototoxin caused 13 outbreaks (27 cases). All four parasitic disease outbreaks (eight cases) were due to *Trichinella spiralis*. Viral agents (10 hepatitis A outbreaks and one Norwalk virus outbreak) accounted for 550 cases. The Norwalk virus outbreak involved 20 persons and was associated with consumption of raw clams.

Thirty-five deaths from foodborne illness were reported: 18 from *L. monocytogenes*, seven from *Salmonella*, three from *Streptococcus*, three from *C. botulinum*, one from *Campylobacter jejuni*, one from hepatitis A, one from *Brucella*, and one from mushroom poisoning. Incubation periods were known for illnesses in 386 outbreaks. In 21 outbreaks, the incubation period was less than 1 hour; in 107, it was 1-7 hours; in 85, it was 8-14 hours; and in 173 outbreaks, it was greater than or equal to 15 hours.

The food vehicle of transmission was determined in 74% of the 187 outbreaks in which a pathogen was identified (Table 6). Fish was the vehicle of transmission in 58% of the outbreaks of diseases caused by chemicals. Food eaten in a restaurant was associated with 47% of outbreaks, and food eaten at home, with 24% (Table 11). The proportion of foodborne illness due to known etiologic agents was highest in September (Table 16). 1984

In 1984, 543 outbreaks (16,420 cases) of foodborne disease were reported to CDC. Reports were received from 38 states as well as from the District of Columbia, Guam, and Puerto Rico (Figure 2). New York reported the largest number of outbreaks (162), with 46 from New York City; Washington reported the next largest number (43), followed by California (38) and Florida (34). The etiologic agent was confirmed in 185 (34%) of the 543 outbreaks (Table 2).

Bacterial pathogens accounted for 128 outbreaks (7,307 cases). *Salmonella* caused most of the bacterial foodborne disease outbreaks (78 outbreaks, 4,479 cases) followed by *S. aureus* (11 outbreaks, 1,153 cases), and *Clostridium perfringens* (eight outbreaks, 882 cases). An outbreak of *E. coli* 0157:H7 infection associated with hamburger occurred in a nursing home in Nebraska. This was the third reported foodborne outbreak due to this organism in the United States, the first two having occurred in 1982. Thirty-four persons were ill, 14 were hospitalized, and four died. An outbreak of *Salmonella typhimurium* infection affected over 700 persons in a small Oregon town. Most ill persons had eaten at a salad bar in one of 10 implicated restaurants; the salad bar had been deliberately contaminated. An outbreak of gastroenteritis due to enterotoxigenic *E. coli* involved 42 persons who ate Seafood Newburg in Maine.

Chemical agents caused 42 outbreaks (216 cases). All 11 parasitic disease outbreaks were caused by *T. spiralis* (60 cases). Three of these outbreaks were associated with consumption of bear meat. Viral agents caused four outbreaks (610 cases).

Twelve deaths from foodborne illness were reported: four from *E. coli*, three from *Salmonella*, two from *C. perfringens*, one from *Shigella*, one from consumption of water hemlock, and one from unknown etiology. Incubation periods were known for illnesses in 405 outbreaks. In 18 outbreaks, the incubation period was less than 1 hour; in 118, it was 1-7 hours; in 93, it was 8-14 hours; and in 176, it was greater than or equal to 15 hours.

The food vehicle of transmission was determined in 70% of the 185 outbreaks in which a pathogen was identified (Table 7). Fish was the vehicle of transmission in 75% of the outbreaks of diseases caused by chemicals. Food eaten in a restaurant was associated with 44% of the outbreaks, and food eaten at home, with 25% (Table 12). The proportion of foodborne illness due to known etiologic agents was highest in August (Table 17). 1985

In 1985, 495 outbreaks (31,079 cases) of foodborne disease were reported to CDC. Reports were received from 45 states, as well as from the District of Columbia, the U.S. Virgin Islands, and Guam (Figure 3). New York reported the largest number of outbreaks (143), with 36 from New York City; Washington reported the next largest number (60), followed by Hawaii (36) and California (31). The etiologic agent was confirmed in 220 (44%) of the 495 outbreaks (Table 3).

Bacterial pathogens accounted for 143 outbreaks (22,132 cases). *Salmonella* caused most of the bacterial foodborne disease outbreaks (79 outbreaks, 19,660 cases), followed by *C. botulinum* (17 outbreaks, 33 cases) and *S. aureus* (14 outbreaks, 421 cases). The largest single foodborne outbreak ever reported to CDC was caused by *S. typhimurium* in 1985. The outbreak was associated with 2% low-fat pasteurized milk produced by a dairy plant in Chicago. The number of ill persons was estimated to be greater than 150,000. There were greater than 16,000 culture-confirmed cases, at least 2,777 persons hospitalized, and 14 deaths with which salmonellosis may have been associated. The use in the month before illness of antimicrobials to which the organism was resistant increased the risk of illness. A statewide outbreak of chloramphenicol-resistant *Salmonella* Newport infection occurred in California. Illness was associated with ground beef eaten during the week before onset and with the use of penicillin or tetracycline during the month before onset. The epidemic strain was traced from humans back through hamburger meat processors and abattoirs to dairy farms where chloramphenicol was used. An outbreak of *L. monocytogenes* infections due to Mexican-style soft cheese was centered in California. Over 150 persons became ill, most of whom were pregnant women or their offspring; the fatality rate was 34%. Investigation of the implicated factory suggested that the cheese was commonly contaminated with unpasteurized milk.

Chemical agents caused 58 outbreaks (392 cases). Nine outbreaks (52 cases) were due to parasites. Viral agents caused 10 outbreaks (411 cases).

Seventy-six deaths from foodborne illness were reported: 52 from *L. monocytogenes*, 20 from *Salmonella*, two from *C. botulinum*, one from *T. spiralis*, and one from an unknown pathogen. Incubation periods were known for illnesses in 373 outbreaks. In 18 outbreaks, the incubation period was less than 1 hour; in 105, it was 1-7 hours; in 90, it was 8-14 hours, and in 160, it was greater than or equal to 15 hours.

The food vehicle of transmission was determined in 75% of the 220 outbreaks in which a pathogen was identified (Table 8). Fish or shellfish were the vehicles of transmission in 75% of the outbreaks of diseases caused by chemicals. Food eaten in a restaurant was associated with 41% of outbreaks, and food eaten at home, with 28% (Table 13). The proportion of foodborne illness due to known etiologic agents was highest in August (Table 18). 1986

In 1986, 467 outbreaks (12,781 cases) of foodborne disease were reported to CDC. Reports were received from 38 states, as well as from the District of Columbia, Guam, and Puerto Rico (Figure 4). New York reported the largest number of outbreaks (129), with 30 from New York City; Washington reported the next largest number (55), followed by California (36), and Hawaii (28). The etiologic agent was confirmed in 181 (39%) of the 467 outbreaks (Table 4).

Bacterial pathogens accounted for 119 outbreaks (4,855 cases). *Salmonella* caused most of the bacterial foodborne disease outbreaks (61 outbreaks, 2,833 cases), followed by *C. botulinum* (22 outbreaks, 27 cases) and *Shigella* (13 outbreaks, 773 cases). In Texas, 347 persons contracted *Shigella sonnei* gastroenteritis. Shredded lettuce was implicated. Examination of the plant suggested that a food handler may have contaminated the lettuce. Laboratory experiments showed that *Shigella* multiplies on shredded lettuce at room temperature. A multistate outbreak of *Salmonella enteritidis* infections caused by commercially frozen pasta affected greater than 100 persons. Thirteen were hospitalized, and one person died. The implicated pasta was labeled as fully cooked, although it contained raw eggs.

Chemical agents caused 48 outbreaks (215 cases). Parasites caused eight outbreaks (68 cases), of which two were associated with *G. lamblia*. In one outbreak, fruit salad eaten at a family gathering in New

Jersey was the vehicle. The woman who made the salad had an asymptomatic child in diapers; *Giardia* was identified in stool samples from the mother, the child, and their pet rabbit. Another outbreak of *Giardia* infection was associated with consumption of sandwiches at a nursing home. Viral agents caused six outbreaks. Most of the 666 cases were due to Norwalk virus.

Eleven deaths from foodborne illness were reported, all of which were associated with bacterial pathogens: seven from *Salmonella*, three from *C. botulinum*, one from *Shigella*. Incubation periods were known for illnesses in 330 outbreaks. In 19 outbreaks, the incubation period was less than 1 hour; in 87, it was 1-7 hours; in 73, it was 8-14 hours; and in 151 outbreaks, it was greater than or equal to 15 hours.

The food vehicle of transmission was determined in 75% of the 181 outbreaks in which a pathogen was identified (Table 9). Fish or shellfish were the vehicles of transmission in 83% of the outbreaks of diseases caused by chemicals. Food eaten in a restaurant was associated with 45% of outbreaks, and food eaten at home, with 23% (Table 14). The proportion of foodborne illness due to known etiologic agents was highest in July (Table 19). 1987

In 1987, 387 outbreaks (16,500 cases) of foodborne disease were reported to CDC. Reports were received from 34 states as well as from the District of Columbia and Puerto Rico (Figure 5). New York reported the largest number of outbreaks (136), with 24 from New York City; Washington reported the next largest number (47), followed by California (31) and Wisconsin (21). The etiologic agent was confirmed in 136 (35%) of the 387 outbreaks (Table 5).

Bacterial pathogens accounted for 83 outbreaks (8,928 pathogens). *Salmonella* caused most of the bacterial foodborne disease outbreaks (52 outbreaks, 1,846 cases), followed by *C. botulinum* (11 outbreaks, 18 cases) and *Shigella* (9 outbreaks, 6,494 cases). Of the many outbreaks caused by *S. enteritidis*, one involved 40 people who ate eggs at a restaurant in Delaware. An outbreak of *S. sonnei* infection occurred at a mass gathering in a North Carolina forest. Thousands of attendees became ill; illness was associated with communal meals and poor hygienic conditions.

Chemical agents caused 39 outbreaks (157 cases), including 95 cases caused by scombrototoxin. All four parasitic disease outbreaks (15 cases) were caused by *T. spiralis*. Of the 10 viral outbreaks, nine were caused by hepatitis A, but most of the 552 cases were from the one Norwalk virus outbreak.

Five deaths from foodborne illness were reported: two from *C. botulinum*, two from *Salmonella*, and one from mushroom poisoning. Incubation periods were known for 284 outbreaks. In 15 outbreaks, the incubation period was less than 1 hour; in 56, it was 1-7 hours; in 64, it was 8-14 hours; and in 149, it was greater than or equal to 15 hours.

The food vehicle of transmission was determined in 58% of the 136 outbreaks in which a pathogen was identified (Table 10). Fish was the vehicle of transmission in 85% of the outbreaks of diseases caused by chemicals. Food eaten in a restaurant was associated with 58% of outbreaks, and food eaten at home, with 12% (Table 15). The proportion of foodborne illness due to known etiologic agents was highest in July (Table 20). DISCUSSION

Among outbreaks in which the etiology was determined, bacterial pathogens caused the largest number of outbreaks (66%) and cases (92%) during the years 1983-1987. Chemical agents caused 26% of the outbreaks and 2% of the cases; parasites, 4% of the outbreaks and less than 1% of the cases; and viruses, 5% of the outbreaks and 5% of the cases. These proportions are similar to those of previous years. The discrepancies between the number of outbreaks and the number of cases attributed to each etiologic agent emphasizes the importance of evaluating both numbers before drawing conclusions about the contribution of particular pathogens or vehicles to foodborne disease.

Salmonella accounted for 57% of the bacterial disease outbreaks for the 5-year period and was the most frequently reported bacterial pathogen for each year. Fish poisoning due to ciguatoxin and scombrototoxin accounted for 73% of the outbreaks due to chemical agents. *T. spiralis* caused all parasitic disease

outbreaks for 3 of the 5 years; three *Giardia* outbreaks occurred during the other 2 years. Hepatitis A caused 71% of the outbreaks due to viruses. The low number of reported outbreaks due to Norwalk agent and other viruses reflects the limitations of current laboratory techniques for detecting these infections.

The number of reported outbreaks decreased by 23% between 1983 and 1987. This decrease does not necessarily represent a true decrease in the number of foodborne disease outbreaks, because the number of sporadic cases of *Salmonella* infection (reported to a different surveillance system) has increased over this period. Many of these sporadic cases suggest unreported outbreaks. The decrease in reported outbreaks parallels the increased workload placed on health departments by the acquired immunodeficiency syndrome (AIDS) epidemic and is most likely due to limited resources for outbreak investigations. Although the number of reported outbreaks decreased, the number of cases involved in outbreaks did not.

The number of outbreaks in which the etiologic agent was not confirmed was about 60% for each of the 5 years from 1983 to 1987. This large percentage reflects the need for improved investigative skills so that known pathogens can be identified more frequently, and new and unidentified pathogens can be recognized.

Inconsistencies in reporting can be seen by examining the distribution of outbreaks by state. A few states, such as New York, California, Washington, and Hawaii, account for a disproportionate number of the outbreaks. Although these states could have a higher rate of foodborne disease, these figures more likely represent differences in degree of surveillance activity. Variability in reporting can also be seen when the frequencies of different pathogens are studied. Outbreaks due to *C. botulinum* were reported more commonly than those due to *Campylobacter*, a finding that indicates only that botulism is reported more comprehensively than some other illnesses.

For each year from 1983 to 1987, the most commonly reported food-preparation practice that contributed to foodborne disease was improper storage or holding temperature, followed by poor personal hygiene of the food handler (Tables 21-25). Food obtained from an unsafe source was the least commonly reported factor for all 5 years. Inadequate cooking and contaminated equipment each ranked third or fourth in each of the 5 years. In most outbreaks caused by bacterial pathogens, the food was stored at improper holding temperatures. In outbreaks of trichinosis, the food was usually inadequately cooked. In outbreaks of ciguatera and mushroom poisoning, the food itself was unsafe, and illness was not related to improper handling or preparation.

The objective of this report is to present simple analyses of the data on outbreaks of foodborne disease reported for the years 1983-1987. Because of the size and complexity of the data base and the limitations noted under Interpretation of Data, no attempt has been made to draw sweeping conclusions. Rather, these data will be analyzed in detail, along with other relevant data, to answer questions of public health importance, and findings will be published in the scientific literature.

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